May 1966 Brief 66-10225

NASA TECH BRIEF

Single-Crystal Semiconductor Films Grown on Foreign Substrates

The problem:

To grow single-crystal films of a semiconductor material on a substrate of foreign material, that is a material whose pertinent physical characteristics (lattice constant, thermal expansion coefficient, etc.) do not match those of the semiconductor material, thereby precluding epitaxial growth.

The solution:

Form an intermediate alloy between the foreign substrate (made of an appropriate metal) and the semiconductor material and grow the crystal film of this material on the alloy layer.

How it's done:

In one system, molybdenum sheet is used as the substrate and germanium as the semiconductor material for the film. The germanium is evaporated onto the molybdenum sheet and the temperature is increased, allowing the germanium to alloy with the surface layers of the molybdenum at a relatively high temperature, but below the melting point of the molybdenum. Vapor deposition of the germanium is repeated, but this time the alloying temperature is held somewhat lower than in the first step. In this manner, a molybdenum-germanium alloy of varying composition, having a melting point lying between the melting points of the molybdenum and germanium, is built up on the molybdenum substrate. Finally, a germanium layer, which will melt without appreciably reacting with the underlying alloy, is evaporated onto the alloy. The germanium layer can then be melted and recrystallized into single-crystal semiconductor films by any of a variety of methods, including seeding, normal solidification, and zone solidification. The recrystallized germanium film is in turn used as a substrate for the epitaxial growth of germanium or other semiconductors, such as gallium arsenide.

Notes:

1. In carrying out this process the melted semiconductor film must not ball up on the surface of the substrate and neither chemically react nor alloy with the intermediate alloy formed on the substrate.
2. The melting point of the base material must be higher than that of the film material.
3. Inquiries concerning this innovation may be directed to:

   Technology Utilization Officer
   Western Operations Office
   150 Pico Boulevard
   Santa Monica, California, 90406
   Reference: B66-10225

Patent status:

No patent action is contemplated by NASA.

Source: Paul Vohl
of Radio Corporation of America
under contract to
Western Operations Office
(WOO-076)

Category 01